REMARKS

The Office Action dated February 19, 2008 and the Advisory Action dated May 16, 2008 have been received and carefully noted. The above amendments to the claims, and the following remarks, are submitted as a full and complete response thereto.

Claims 1, 10 and 11 have been amended to more more particularly point out and distinctly claim the subject matter of the invention. Support for the claim amendments may be found at least in paragraph 0025 of the specification. No new matter has been added. Claims 1-4, 6-14, and 16-19 are therefore currently pending in the application and are respectfully submitted for consideration.

The final Office Action rejected claims 1, 2, 8, and 10 under 35 U.S.C. §102(b) as being anticipated by Pikkarainen (U.S. Patent No. 5,701,106). Claims 5, 11, 12, 15 and 18 were rejected under 35 U.S.C. §103(a) as being unpatentable over Pikkarainen. The Advisory Action of May 16, 2008 maintained these rejections. The rejections are respectfully traversed for at least the following reasons.

Claim 1, upon which claims 2-9 are dependent, recites a method which includes performing delta sigma modulation on a digital quadrature signal, converting the modulated signal to an analog signal, converting the analog signal to an RF signal, and transmitting the RF signal. The performing of the delta sigma modulation comprises performing 2nd order delta sigma modulation to output 4 bits from a 10 bit input.

Claim 10 recites a system including means for performing delta sigma modulation on a digital quadrature signal, means for converting the modulated signal to an analog

signal, means for converting the analog signal to an RF signal, and means for transmitting the RF signal. The means for performing delta sigma modulation comprises means for performing 2nd order delta sigma modulation to output 4 bits from a 10 bit input.

Claim 11, upon which claims 12-14 and 16-19 are dependent, recites an RF transmitter comprising a delta sigma modulator capable of performing delta sigma modulation on a digital quadrature signal. The RF transmitter further includes a DAC, communicatively coupled to the delta sigma modulator, capable of converting the modulated signal to an analog signal, a mixer, communicatively coupled to the DAC, capable of converting the analog signal to an RF signal, and an antenna, communicatively coupled to the mixer, capable of transmitting the RF signal. The delta sigma modulator comprises a 2nd order delta sigma modulator configured to output 4 bits from a 10 bit input.

Therefore, embodiments of the invention provide a system and method that use less hardware and power than conventional transmitters without substantially reducing clarity of the data carried in the RF signals.

As will be discussed below, Pikkarainen fails to disclose or suggest all of the elements of the claims, and therefore fails to provide the advantages and features discussed above.

Pikkarainen discloses a modulation method and modulator with which a complex signal can be modulated and shifted directly from the baseband frequency to an intermediate frequency or even directly from the baseband frequency to the transmission

frequency. This is achieved by taking samples from the incoming bit stream with a D/A converter, preferably a sigma-delta type D/A converter, and selecting as output directly a multiple of the sampling frequency provided by the D/A converter. The conversion produces a baseband signal and signals at multiples of the sampling frequency. The sampling frequency is increased, according to a sigma-delta D/A conversion, and one of the signals at multiples of the sampling frequency, produced by the conversion, is selected as the output signal. A multiple at the D/A converter output that is at the desired intermediate frequency or at the transmission frequency is selected.

Applicants respectfully submit that Pikkarainen fails to disclose or suggest all of the elements of the present claims. For example, Pikkarainen does not disclose or suggest, at least, "wherein the performing of the delta sigma modulation comprises performing 2^{nd} order delta sigma modulation to output 4 bits from a 10 bit input," as recited in claim 1 and similarly recited in claim 10. Similarly, Pikkarainen fails to disclose or suggest that "the delta sigma modulator comprises a 2^{nd} order delta sigma modulator configured to output 4 bits from a 10 bit input," as recited in claim 11. Therefore, according to embodiments of the invention, the delta sigma modulators 240a and 240b are second order delta sigma modulators that output 4 bits from a 10 bit input (see Specification, paragraph 0025 and Figure 2).

Applicants respectfully submit that Pikkarainen does not disclose or suggest second order delta sigma modulators that output 4 bits from a 10 bit input. Rather, Pikkarainen merely discloses that, in sigma-delta D/A converters, the sampling frequency

is first increased by interpolating and then the number of bits in the samples is decreased, whereby a stream of words containing several bits can be converted to a stream of 1-bit words (Pikkarainen, Column 4, lines 51-55). Additionally, Pikkarainen specifically discloses that the "signals obtained from the interpolators/sinc filters 90 are further taken to sigma-delta modulators 91 (noise shaping blocks), which provide at their outputs 1-bit signals" (Pikkarainen, Column 5, lines 54-56, and Figure 5). Thus, Pikkarainen merely discloses sigma-delta modulators that provide a 1-bit output.

The Office Action acknowledges that Pikkarainen does not disclose 2nd order delta sigma modulation. Pikkarainen only mentions 1st or 5th order delta sigma modulation. The Office Action, however, concluded that it would have been obvious to a person of ordinary skill in the art to modify Pikkarainen to utilize 2nd order delta sigma modulation because using a higher order delta sigma modulation will result in higher signal to noise ratio (see Office Action, page 5). Applicants submit that, even if it were obvious to a person of ordinary skill in the art to modify Pikkarainen to include a 2nd order delta sigma modulator (which is not admitted), it would not have been obvious to a person of ordinary skill in the art to modify Pikkarainen to include a 2nd order delta sigma modulator that outputs 4 bits from a 10 bit input. As outlined above, Pikkarainen merely discloses sigma-delta modulators that provide a 1-bit output.

Therefore, Applicants respectfully submit that Pikkarainen does not disclose or suggest, at least, "wherein the performing of the delta sigma modulation comprises performing 2nd order delta sigma modulation to output 4 bits from a 10 bit input," as

recited in claim 1 and similarly recited in claim 10. Similarly, Pikkarainen fails to disclose or suggest that "the delta sigma modulator comprises a 2nd order delta sigma modulator configured to output 4 bits from a 10 bit input," as recited in claim 11. Applicants respectfully request that the rejection of claims 1, 10 and 11 be withdrawn.

Claims 2, 8, 12, and 18 are dependent upon claims 1 and 11, respectively. Thus, claims 2, 8, 12, and 18 should be allowed for at least their dependence upon claims 1 and 11, and for the specific limitations recited therein.

The Office Action rejected claims 3, 4, 13, and 14 under 35 U.S.C. §103(a) as being unpatentable over Pikkarainen in view of Lipka (U.S. Patent No. 7,227,910). The Office Action took the position that Pikkarainen discloses all of the limitations of the claims, with the exception of reducing the number of bits from 10 to 4 and amplifying the RF signal before transmitting. The Office Action then cited Lipka as allegedly curing these deficiencies in Pikkarainen. This rejection is respectfully traversed for at least the following reasons.

Pikkarainen is discussed above. Lipka discloses providing sigma-delta modulators with a configurable output bit width so that the output bit width of the interpolation filters can be easily adapted to the input bit width of a chosen digital-to-analogue converter without the need to change the internal design of a baseband processing circuit.

Claims 3, 4, 13, and 14 are dependent upon claims 1 and 11, respectively. As discussed above, Pikkarainen fails to disclose or suggest second order delta sigma modulators that output 4 bits from a 10 bit input. The Office Action alleged that Lipka

cures this deficiency in Pikkarainen (see Office Action, pages 4-5). Applicants respectfully disagree. Lipka, like Pikkarainen, does not disclose or suggest second order delta sigma modulators that output 4 bits from a 10 bit input. Rather, Lipka merely discloses that the "usage of digital-to-analogue converters with a higher number of input bits also makes it possible to use a lower over-sampling factor" (Lipka, Column 2, lines 45-47). Therefore, the combination of Pikkarainen and Lipka fails to disclose or suggest performing 2nd order delta sigma modulation to output 4 bits from a 10 bit input," as recited in claim 1 and similarly recited in claim 11. Accordingly, the combination of Pikkarainen and Lipka does not disclose or suggest all of the elements of claims 3, 4, 13, and 14. Furthermore, claims 3, 4, 13, and 14 should be allowed for at least their dependence upon claims 1 and 11, and for the specific limitations recited therein.

Claim 6 was rejected under 35 U.S.C. §103(a) as being unpatentable over Pikkarainen in view of Hossack (U.S. Patent No. 6,819,276). The Office Action took the position that Pikkarainen discloses all of the elements of the claim, with the exception of coding the modulated signal with a thermometer code. The Office Action then cited Hossack as allegedly curing this deficiency in Pikkarainen. This rejection is respectfully traversed for at least the following reasons.

Pikkarainen is discussed above. Hossack discloses a noise-shaper system which includes a scrambler coupled to receive the output of a randomizer. The randomizer has an input for receiving a plurality of parallel equally weighted bits in a first sequence, and a first output which provides said bits in a pseudorandom sequence with a transformation

that is not dependant on said first sequence. The scrambler is coupled to receive the randomizer's output and, in response, to produce a second non-pseudorandom sequence of the bits at a second output with a transformation that is dependent on the pseudorandom sequence. The resultant output is noise shaped to reduce distortion.

Claim 6 is dependent upon claim 1. As discussed above, Pikkarainen fails to disclose or suggest all of the elements of claim 1. Furthermore, Hossack fails to cure the deficiencies in Pikkarainen as Hossack also fails to disclose or suggest 2nd order delta sigma modulation that outputs 4 bits from a 10 bit input. Thus, the combination of Pikkarainen and Hossack does not disclose or suggest all of the elements of claim 6. Additionally, claim 6 should be allowed for at least its dependence upon claim 1, and for the specific limitations recited therein.

Claims 7 and 17 were rejected under 35 U.S.C. §103(a) as being unpatentable over Pikkarainen in view of Norsworthy (U.S. Patent No. 5,512,898). The Office Action took the position that Pikkarainen discloses all of the elements of the claims, with the exception of modulating the quadrature signal prior to performing delta sigma modulation. The Office Action then cited Norsworthy as allegedly curing this deficiency in Pikkarainen. This rejection is respectfully traversed for at least the following reasons.

Pikkarainen is discussed above. Norsworthy discloses a data converter which includes an analog-to-digital converter for converting an incoming analog signal into a plurality of digital signal samples, followed by a minimum phase FIR filter to filter the digital signal samples. Alternatively, the data converter includes a digital-to-analog

converter preceded by a minimum phase FIR filter to filter a plurality of digital signal samples that are converted into an analog signal by the digital-to-analog converter. The data converter may include both analog-to-digital and digital-to-analog conversion.

Claims 7 and 17 are dependent upon claims 1 and 11, respectively. As discussed above, Pikkarainen fails to disclose or suggest all of the elements of claims 1 and 11. Furthermore, Norsworthy fails to cure the deficiencies in Pikkarainen as Norsworthy also fails to disclose or suggest 2nd order delta sigma modulation that outputs 4 bits from a 10 bit input. Thus, the combination of Pikkarainen and Norsworthy does not disclose or suggest all of the elements of claims 7 and 17. Additionally, claims 7 and 17 should be allowed for at least their dependence upon claims 1 and 11, and for the specific limitations recited therein.

Claims 9 and 19 were rejected under 35 U.S.C. §103(a) as being unpatentable over Pikkarainen in view of Fujimori (U.S. Patent No. 6,326,912). The Office Action took the position that Pikkarainen discloses all of the elements of the claims, with the exception of the interpolation filtering reducing the digital quadrature signal from 12 bits to 10 bits. The Office Action then cited Fujimori as allegedly curing this deficiency in Pikkarainen. This rejection is respectfully traversed for at least the following reasons.

Pikkarainen is discussed above. Fujimori discloses an analog-to-digital converter for converting an analog signal to a one-bit digital bit stream. The analog-to-digital converter uses a multi-bit analog delta-sigma modulator coupled to receive the analog input signal, and a one-bit digital delta-sigma modulator coupled to receive the digital

output from the multi-bit analog delta-sigma modulator. The analog delta-sigma modulator uses a multi-bit quantizer having minimal quantization noise, and the digital delta-sigma modulator converts the multi-bit quantizer output into a single bit delta-sigma digital format compatible with digital audio systems which require a one-bit delta-sigma format.

Claims 9 and 19 are dependent upon claims 1 and 11, respectively. As discussed above, Pikkarainen fails to disclose or suggest all of the elements of claims 1 and 11. Furthermore, Fujimori fails to cure the deficiencies in Pikkarainen as Fujimori also fails to disclose or suggest 2nd order delta sigma modulation that outputs 4 bits from a 10 bit input. Thus, the combination of Pikkarainen and Fujimori does not disclose or suggest all of the elements of claims 9 and 19. Additionally, claims 9 and 19 should be allowed for at least their dependence upon claims 1 and 11, and for the specific limitations recited therein.

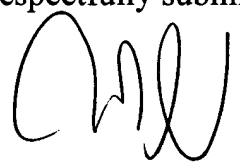
Applicants respectfully submit that the cited prior art fails to disclose or suggest all of the elements of the claimed invention. These distinctions are more than sufficient to render the claimed invention unanticipated and unobvious. It is therefore respectfully requested that all of claims 1-4, 6-14, and 16-19 be allowed, and this application passed to issue.

If for any reason the Examiner determines that the application is not now in condition for allowance, it is respectfully requested that the Examiner contact, by

telephone, the applicants' undersigned representative at the indicated telephone number to arrange for an interview to expedite the disposition of this application.

In the event this paper is not being timely filed, the applicants respectfully petition for an appropriate extension of time. Any fees for such an extension together with any additional fees may be charged to Counsel's Deposit Account 50-2222.

Respectfully submitted,



Majid S. AlBassam
Registration No. 54,749

Customer No. 32294
SQUIRE, SANDERS & DEMPSEY LLP
14TH Floor
8000 Towers Crescent Drive
Vienna, Virginia 22182-6212
Telephone: 703-720-7800
Fax: 703-720-7802

Enclosures: Request for Continued Examination (REC) Transmittal